CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH
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R. W. Brock, Director

MEMOIR No. 4

GEOLOGICAL RECONNAISSANCE

ALONG THE LINE OF THE

NATIONAL TRANSCONTINENTAL RAILWAY

IN

WESTERN QUEBEC

BY

W. J. WILSON

OTTAWA
GOVERNMENT PRINTING BUREAU
1910

No. 1110

9913—1

LETTER OF TRANSMITTAL.

R. W. Brock,
Director Geological Survey,
Department of Mines.

Sir,—I beg leave to submit the following memoir on a Geological Reconnaissance along the National Transcontinental Railway line in western Quebec.

I have the honour to be, sir,
Your obedient servant,

(Signed) W. J. WILSON,

Ottawa, May 21, 1908.

CONTENTS.

	Page.
Historical introduction	7
General description of railway	8
Area examined	9
Trees and shrubs	9
Forest types	10
General Geology	12
Keewatin	12
Laurentian	13
Petrographic description	14
Description of routes	15
Fly river	15
Kakameonan river	15
Makamik lake	16
Lois lake	16
Height of land portage	16
Nawapitechin river	17
Along railway eastward from Makamik lake	17
Kinojevis cache, to Seals Home lake	18
Seals Home lake	19
Harricanaw river	19
Askogwash river	20
Natagagan lake and river	21
Along railway eastward from Harricanaw river	22
Wabanoni lake	23
Obaska lake and adjacent railway line	23
Migiskan river	24
Sunday brook	25
Crooked creek	26
Assup river	26
Along railway east and west of Crooked creek	27
Millie lake	27
Smoky creek and Cedar creek	28
The Atik river and adjacent country	28
Durant lake	30
Durant lake to Kekek river	31
Kekek river to Kapitachuan	32
Whiteshore lake	33
Description of rock exposures	33
Fly river	33
Along railway eastward from Fly river	35
Kakameonan and Makamik lakes	35
Height of land portage and Nawapitechin river	35
Seals Home lake and Harricanaw river	36
Askogwash river	37
Natagagan lake and river	37

Page.

Description of rock exposures—*Continued.*
Wabanoni river.. 38
Obaska lake.. 39
Migiskan river.. 40
Millie river 42
Atik river 42
Durant lake.. 44
Durant lake to Kekek river.. 45
Kekek river to Whiteshore lake 45
Economic geology—
Chalcopyrite.. 46
Molybdenite.. 47
Gold and bismuthenite.. 48
Iron.. 49
Clay.. 49
Asbestos.. 49
Timber 49
Glaciation.. 50
Railway levels.. 51
Index.. 52

ILLUSTRATIONS.

Plate I. Beaver dam, Nawapitechin river.. .. ..Frontispiece
" II. Fly river, east of Makamik lake 16
" III. Cache No. 9, Nawapitechin river.. 18
" IV. Natagagan river. Forest showing dead tamarack 22
" V. Height of land on portage east of Lois lake.. 36

MAP.

No. 1112. Reconnaissance Geological Map of the country traversed by the National Transcontinental railway from Susie river to the Interprovincial boundary, Quebec.

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1906-1907

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HISTORICAL INTRODUCTION.

The region covered by this memoir is situated in western Quebec, and extends ten miles north and south of the National Transcontinental railway, from Makamik lake to the Susie river. It lies between 75° 30′ and 79° 30′ west longitude, and 48° and 49° north latitude.

The following work had already been done in this area:—

In 1887, Mr. A. C. Cochrane, Dr. R. Bell's assistant, made a track survey of the Bell river down to the rapids ten miles below Shabogama lake.[1]

In 1895-6, Dr. R. Bell examined and reported on the same river.[2]

In 1896, Mr. R. W. Brock—Dr. Bell's assistant—made a track survey of the Migiskan river from the mouth up to and beyond the border of the map.[3]

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[1] Geological Survey of Canada. Report of Progress, 1887, pp. 24-25 A.

[2] Geological Survey of Canada: Annual Report (New Series) 1895, p. 74 A; Annual Report (New Series) 1896, p. 64 A; Annual Report (New Series) 1900, K.

[3] Geological Survey of Canada. Annual Report (New Series) 1896, p. 68 A.

In 1894, Mr. Henry O'Sullivan, Inspector of Surveys for the Province of Quebec, made a track survey of a part of the Bell river, and also of a part of the Migiskan and Kekek rivers, and the canoe route from the latter to Kapitachuan lake, and made a short report.[1]

In 1893, Mr. John Bignell, P.L.S., surveyed the headwaters of the Ottawa river in this area, including the Kinojevis and the Nawapitechin rivers, and wrote a brief report on them.[2]

In 1901, Mr. J. F. E. Johnston surveyed and reported on Makamik lake, and Lois river and lake.[3]

In 1905, Mr. C. L. Harvey made a stadia survey of the Fly river and the canoe route to the Kinojevis cache No. 9, via Makamik lake, Lois river and lake, and the Nawapitechin river.

From 1905 to 1907 the engineers of the National Transcontinental railway have run lines with chains and transit, and sketched the topography adjacent to the lines, throughout the whole distance east and west.

During the summers of 1906 and 1907 I made a compass and micrometer survey of all the larger rivers and lakes in the area, which had not been previously surveyed, except a few in the eastern part. Among those thus surveyed are Seals Home lake, Harricanaw river, Askogwash river, Natagagan lake and river, Wabanoni lake, Migiskan river from the westerly crossing of the railway line to the head of Millie lake, Atik river, and Atik, Couillard, and Durant lakes, also the lower part of Assup river. Besides these, track surveys were made of several streams which were too small to be measured with the micrometer with reasonable speed, and also the canoe route from Durant lake to Whiteshore lake.

GENERAL DESCRIPTION OF NATIONAL TRANSCONTINENTAL RAILWAY.

The National Transcontinental railway runs east and west through the area for 187 miles. It passes north of the height of land for a short distance east of Robertson lake, where it crosses the watershed and runs along the south side up to near Molesworth lake, where it again follows the Hudson Bay slope up to the headwaters of the Kapitachuan river. Here it crosses the height of land,

[1] Report of Quebec Crown Lands Department, 1895, p. 100.
[2] Report of Quebec Crown Lands Department, 1895, p. 129.
[3] Geological Survey of Canada. Summary Report, 1901, p. 130 A.

and for a short distance runs along the south slope, but soon recrosses, and continues on the north side beyond the limits of the sheet.

GENERAL DESCRIPTION OF AREA EXAMINED.

The country traversed by the line in the eastern part is about 1,000 feet above sea-level, and is comparatively flat. It is well watered, rivers and lakes being abundant. The general flatness is occasionally broken by hills, rising 100 feet to 200 feet above the common level. These hills are mostly granite.

The soil is largely clay, or a clay loam, and, especially in the river valleys, is rich, free from stones, and well adapted for agricultural purposes. In places it is sandy and dry, and there are areas where the rock either protrudes or has only a light covering of soil; such places, however, occupy but a small portion of the whole country. The largest areas of waste land are due to muskeg and swamp, and both these owe their present condition to lack of drainage. These conditions prevail as far east as the Migiskan crossing at Millie lake, and in some respects beyond it, but the eastern part of the sheet presents a different appearance. Large tracts are sandplains, on which is growing an open Banksian pine forest. This country is underlain by a quartzose granular gneiss, which weathers deeply and has produced immense quantities of sand. This part of the country is in places hilly, the elevations sometimes reaching 500 feet above the general level, which at the Susie river is 1,394 feet. There is very little good agricultural land here, but this condition is characteristic of a strip of varying width along the height of land both in Ontario and Quebec. The best agricultural soil is farther north, where there is a deep covering of clay and better drainage. The lower level seems to compensate for the higher latitude, and vegetation is very rapid.

Trees and Shrubs.

The principal trees and shrubs in the district are: white spruce (*Picea alba*), black spruce (*Picea nigra*), poplar (*Populus tremuloides*), Banksian pine (*Pinus Banksiana*), canoe birch (*Betula papyrifera*, and variety *cordifolia*), fir (*Abies balsamea*), balm of Gilead (*Populus balsamifera*), black ash (*Fraxinus sambucifolia*), cedar (*Thuya occidentalis*), white pine (*Pinus strobus*), red pine

(*Pinus resinosa*), red maple (*acer rubrum*), wild red cherry (*Pyrus Pennsylvanicus*), rowan tree (*Pyrus americana*), tamarack (*Larix americana*), alder (*Alnus viridus*, and *Alnus incana*), red osier dogwood (*Cornus stolenifera*), mountain maple (*Acer spicatum*), withewood (*Viburnum cassenoides*), high bush cranberry (*Viburnum opulus*), hazel (*Corylus rostrata*), moosewood (*Dirca palustrus*), and willows, black spruce, poplar or canoe-birch, and Banksian pine from the great bulk of the forest. The most abundant and valuable tree is the black spruce, the wood of which is particularly well suited for the manufacture of pulpwood, on account of its close firm fibre. Poplar frequently reaches a diameter of 1 foot to 20 inches, and canoe-birch nearly as great, but the majority of these trees are of smaller size. Banksian pine grows tall and straight, and is usually free from branches on the lower part, but in most places it is not large, rarely exceeding 15 inches in diameter; the average is probably nearer 8 inches or 10 inches. Some of the larger trees will make railway ties, and they are much used by the railway parties for building storehouses and dwellings. Red maple was seen in only a few places, the specimens being small and dwarfed. Balm of Gilead grows to a good size, but is chiefly confined to the river valleys. Fir is fairly common, but does not grow large. Cedar is common along the streams and lake shores, but is usually scrubby and covered with branches. Over most of the area examined, especially in the western part, there are large numbers of dead tamarack trees. These were killed some years ago by the larvæ of the imported larch sawfly, but are still sound and make excellent firewood. In the eastern part there are many young green trees of this species springing up. White and red pine are only seen along the southern border of the area. On the Assup river a mile south of the Migiskan, there are two large white pines, the most northerly seen. One of these measured 9 feet in circumference 1 foot above the ground. It was tall, clean, and straight and without branches for 25 or 30 feet up, and seemed sound and healthy. Most trees as they approach their northern limit become small and stunted. This is particularly noticeable in the black ash and red maple of this region. The pine, however, seems to grow in all its vigour up to its most northerly limit, and as both climate and soil are more favourable farther north, its abrupt termination at this point would seem to be due rather to a lack of means of spreading its seed than to

unsuitable conditions. Red wild cherry and rowan tree are not common. Hazel and mountain maple are found on the better drained slopes where the soil is rich, and alders, willows, and red osier dogwood form almost impenetrable masses along the banks of rivers and brooks.

Forest Types.

These trees and shrubs are grouped according to soil and moisture so as to form distinct forest types, which are repeated all over the area. Among these types are: (1) The black spruce swamp, which is the most common and comprises the largest areas. These swamps are flat, and consequently there is little or no drainage, and the ground is so deeply covered with moss that the moisture is retained for long periods even in dry weather; the forest forming an effectual shade from the sun's rays, and preventing evaporation. These swamps sustain a dense growth of tall, clean, black spruce, ranging up to 40 or 50 feet high; but are usually comparatively small, averaging from 4 inches to 8 inches in diameter. Alders (*A. incana*), are frequently found in the wetter parts of these swamps.

(2) Where the soil is good and the ground rises sufficiently high and has slope enough to afford drainage, white spruce, poplar, canoe-birch, fir, and shrubs such as mountain maple and hazel grow luxuriantly, and form a forest which produces some of the largest trees in the district.

(3) What may be called a distinct forest type, but closely allied to number two, is found along the rivers and lakes. Adjacent to these there is a belt, sometimes of considerable width, which is well drained, and on this is found the largest and best forest in the country. It consists of spruce, poplar, balm of Gilead, canoe-birch, fir, cedar, and sometimes Banksian pine. Close to the water, covering the alluvium deposits, are alders, willows, and other shrubs.

(4) Where sand predominates in the soil there is usually an abundant growth of Banksian pine. This is one of the most beautiful forests in the country, the trees growing tall and straight, without branches on the lower parts. Many of them measure from 10 inches to a foot in diameter, but the majority are not so large. There is usually very little underbrush, so that the forest is open and an unobstructed view can be had for a long distance. In places

where the trees are scattered and exposed their habit of growth is very different, being then low and bushy, with branches from the ground.

(5) There are also dry areas, which are covered by a small scrubby brush consisting of low spruce, small poplar, etc. This forest is especially common along the height of land, where the soil is rocky or barren.

(6) Comparatively large areas are open muskeg. This is covered with stunted spruce and dead tamarack, with an occasional green shoot springing up. The spruce are seldom more than 10 feet high and 2 inches to 3 inches in diameter in the most open parts. In some of these muskegs there are not enough trees to obstruct the view, and one can see objects for a mile or two. The largest muskeg I saw was about three miles long and one to two wide. All gradations between the open muskeg and the dense spruce swamp exist.

(7) Where the original forest was burnt a separate condition prevails. After a forest has been fire swept it takes four or five years for the young shoots to get a good start. The deciduous trees always spring up first in this district, so that poplar and canoe-birch form the chief forest growth for a number of years. Then slowly the spruce begins to push up and overtop the others, and when the forest is thirty to fifty years old it becomes fairly well mixed.

GENERAL GEOLOGY.

Much difficulty was experienced in working out the geology of the district on account of the scarcity of rock exposures. The railway trial and location lines run on or near the height of land plateau, where the country is flat for long distances and the rocks are deeply covered with clay and moss. Except in an occasional hill the outcrops were found along the shores of lakes and the banks of rivers. This is especially true of the western part. East of the Migiskan river in many places on the higher ground rock exposures are frequent.

Keewatin.

From Makamik lake to east of the Bell river the rocks consist largely of green hornblende schists, chlorite schists with small areas of diabase and altered porphyries, and an occasional hill of granite.

The schists vary much, even in small exposures, and are intimately associated with the diabase and altered porphyries, the one grading into the other without any sharp dividing line. Under the microscope these rocks are seen to have undergone much alteration. In the diabase the augite is often largely replaced by hornblende, and the feldspars are charged with much secondary material. The chlorite schists are frequently considerably decomposed, and in many of the hornblende schists the hornblende is secondary in appearance, while many of the thin sections show that the rocks have been sheared and crushed.

In a general way these schists strike east and west, and are either vertical or dip at a high angle. They contain large quantities of pyrite, either in cubic crystals or disseminated specks. Carbonate of lime is also present in most of them, often filling thread like fissures.

As the country is entirely wooded and difficult to traverse there was not sufficient time to separate the different types so as to represent them on the accompanying map. Lithologically they seem to correspond with the rocks of the Keewatin system, and they have been provisionally so coloured. The Keewatin rocks occupy most of the area from the western border of the sheet to the Bell river, and east of the latter on the south railway line. They are also found on both sides of the Assup river a short distance from its mouth, and on the Migiskan river below the mouth of the Atik.

Laurentian.

Elsewhere in the eastern part of the district the rocks are Laurentian gneiss or gneissoid granite, striking from northeast to southeast, in the majority of places observed varying less than 20° from east and west. In some places the granite rises in hills 400 or 500 feet above the general level, and gives the country a rugged and broken appearance. Owing to the clay covering the contact between the schists and gneiss was not seen, and the relations could not be worked out; but there seems to be an area of some miles where occasional outcrops of first one and then the other appear, the intervening distances being covered with clay. Only an approximate line of separation can, therefore, be drawn.

The gneisses and granites were traced for over seventy miles east in a straight line, and, from other explorations, they are known

to extend much farther east, as well as north and south. They present the same character over all the area, except that from the Atik cache eastward they are highly garnetiferous.

Petrographic Description.

Mr. G. A. Young, petrographer of this department, has examined the slides from the rocks brought in from this area, and the microscopic descriptions herein are by him. Of the gneissic rocks he says: amongst the thin sections submitted for microscopic examination a few represent undoubted granites, either virtually unchanged or partly deformed through dynamic agencies. These granites are of normal types, and in every case the coloured constituent is biotite, though this mineral is very sparingly present in three instances.

The remaining sections are of gneissic rocks, varying amongst themselves as regards texture, structure, and proportions of the chief constituents, but usually having the mineralogical compositions of normal biotite granites. In a few instances garnets are present, and in ten cases, common green hornblende accompanies or entirely replaces the mica. Some of the sections present fair evidence that the gneisses represent crushed granites, while none have any distinctive feature that would indicate a clastic origin for the rocks.

In many cases, however, the thin sections reveal gneissic structures, virtually unaccompanied by deformation due to stresses. In such rocks the chief constituents, quartz, plagioclase, and orthoclase feldspar, tend to occur in rounded or polygonal forms. Possibly the foliation, and at times pronounced banding of these varieties are original, and were assumed by the rocks as they first solidified from a state of igneous fusion. Their general appearances, however, seem to indicate that the structures are secondary, and that they were superimposed on an earlier mode, by some process of recrystallization. In many cases such gneisses exhibit cataclastic phenomena, evidently set up after the individuals of feldspar and quartz had assumed their rounded or polygonal outlines.

A few of the rocks show microscopically an augen structure with larger grains of feldspar, or composite individuals of quartz lying in a fine textured ground largely composed of the same minerals. In some instances such varieties seem possibly to have been derived from granitic types, while in other cases they appear originally to have been gneissic forms. Besides such cases there are examples of

both foliated and banded rocks, in which the structures seem to have resulted directly from the crushing or shearing of once coarse-grained rocks, in some instances at least, originally granites.

DESCRIPTION OF ROUTES.

Fly River.

Beginning at the east end of the sheet the first work was done on the Fly river, which is over 2 chains wide at the mouth, and flows from the east into Makamik lake. It is navigable for canoes for about fifteen miles from the mouth. At this point it forks, a small branch coming from the north. Between these branches Owl mountain, which is 275 feet above the river, is situated, some high hills being visible to the northwest and also to the south. The whole country is forest covered, and the soil is a rich clay loam. Spruce 2 feet in diameter is found growing along the banks, but trees of this size are rare. The principal trees are white spruce, black spruce, poplar, balm of Gilead, fir, Banksian pine, on sandy soil, and a few canoe-birch. The mountain maple and the hazel bush grow on rich clay soil back from the river. Numerous shrubs grow along the river banks, as alders and red osier dogwood. Black ash and cedar are also found along the stream.

The Fly river at the forks is forty feet wide, but above this it is small. A beaver dam a short distance up and just above a small rapid, backs the water and makes the river passable for canoes for two miles. There is a rapid about two miles below the forks, which is passed by an 8 chain portage on the north side. The fall is about fifteen feet. A short distance farther down the second portage occurs. It is also on the north side and is 8 chains long, with a fall of eight feet. Below this there is no obstruction until within three-quarters of a mile of the lake, where there is another portage on the north side, 5 chains long, with a fall in the river of 6 feet.

Kakameonan River.

The Kakameonan river enters Makamik lake less than a mile south of the mouth of Fly river, and drains Robertson lake, which is crossed by the location line of the National Transcontinental railway, and is not far north of the east end of Lake Lois. This river, as far as examined, flows through a flat country, with good soil.

Most of the forest is second growth, not more than twenty years old, and part has been burnt recently. The first portage is two and three-quarter miles from the lake. It is on the north side, is 11 chains long, and has a fall of 10 feet. When I was on the river it was blocked by fallen trees and log jams, but these have since been cut out, and now it forms a good canoe route to Robertson lake.

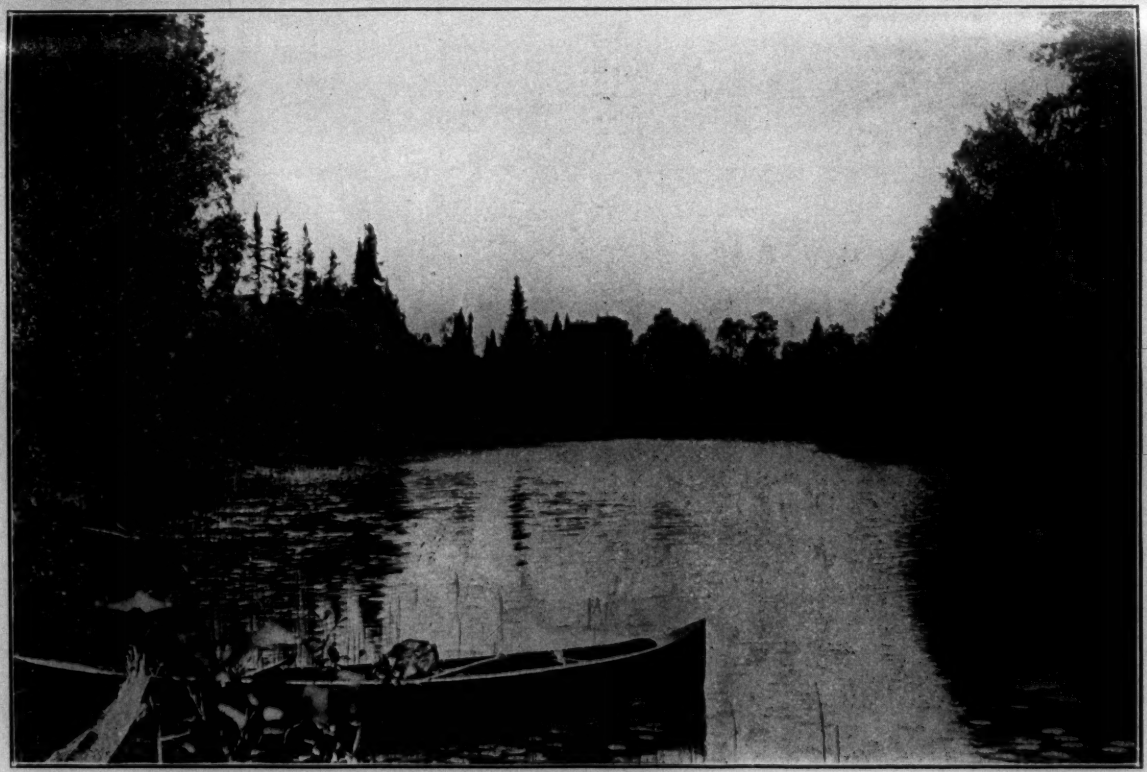
Makamik Lake, Lois Lake, and Height of Land Portage.

Makamik lake is shallow, the water is muddy, and the shores are generally low. It is somewhat circular in form, with a diameter of about six miles. It is drained by the Whitefish river, which flows into Abitibi lake, and receives from the south the Lois river and a small stream called the Ogassasan. The Lois river, which drains a lake of the same name, is eighteen miles long, and has five short portages. It is about 3 chains wide at the mouth, but is considerably wider just below Lake Lois, where it flows through a swampy country for some miles.

Lake Lois is nine miles long, and near the middle narrows to a quarter of a mile in width, and is nowhere more than two miles wide. The average depth is sixteen feet. The Indian name of this lake is Wikwasika. For fuller description of Makamik lake, Lois river and lake, see Mr. Johnston's report already referred to.

A portage over four miles long starts from a small stream at the eastern end of Lake Lois and leads across the height of land to the waters of the Nawapitechin river. Except at one or two places where small streams cross this portage, the land is poor, either rocky or sandy, and covered with Banksian pine; or swampy, approaching muskeg. By climbing elevations a good view of the neighbouring country was obtained. Looking northward from near the middle of the portage the country presents the appearance of a flat plain, with two blue mountains in the distance. Looking south, one mile from the west end, a low range of hills is visible. Like most of the country along the watershed between the St. Lawrence waters and Hudson bay, the land is flat and of little value for agricultural purposes. A few miles on either side the drainage is better, the rocks are more deeply clay covered, and conditions generally are more favourable for vegetation of every description, and for the successful cultivation of the soil.

9313—p. 16



Fly river east of Makamik lake.

Nawapitechin River.

The stream into which the portage leads at the east end is only a few feet wide, and if it were not for beaver dams it would not have been possible to have used it for a canoe route at the season we passed over it. For about five miles, or almost to the upper forks of the Nawapitechin, the stream flows through a beaver meadow, with large open areas, on which grows an abundant supply of wild grass. A rocky barrier half a mile from the forks necessitates a portage, which leads into the river three-quarters of a mile farther down. The north branch of the Nawapitechin, which is the largest of the two, runs southeast for five miles above the forks, and from this point to where it crosses the railway line its general course is southwest. The country through which this branch runs is level, and the soil is a sandy loam, covered chiefly by small Banksian pine and spruce. From the forks down, the Nawapitechin drains the best area of country in the whole region examined. The soil is chiefly a clay loam, and much of it would undoubtedly yield abundant crops, if cleared and cultivated. The banks are heavily wooded throughout its whole course, with large spruce, poplar, canoe-birch, and numerous shrubs. Except in a few places the soil is free from stones. The river is very crooked and its total length is over forty miles. The location line of the railway touches the river at a point about fifteen miles west of the Kinojevis cache, and will open the country for settlers when completed.

Along Railway Eastward from Makamik Lake.

In travelling along the northern exploration railway line from Makamik lake eastward the country shows an alternation of spruce swamp, covered thickly with small spruce which averages 6 inches to 8 inches in diameter; and higher ground covered with larger spruce, poplar, fir, and canoe-birch. As usual at the stream crossings, there are narrow strips well drained and producing a much more luxuriant forest growth.

The country is flat, and although the line runs comparatively straight for long distances, there is only a difference of a few feet in the levels. Eight to ten miles east of Makamik lake there are some rather high granite hills which give the country a rugged and broken appearance. These hills continue for some distance north of the line. East of these hills, along the line, spruce swamps prevail,

with a large number of trees fit for pulpwood, and at the larger streams poplar and canoe-birch, some of the poplar measuring 20 inches in diameter. Farther east there are areas of bouldery ground, and others dry and sandy, covered with scrub spruce and Banksian pine. Very little of the land along this part of the line is fit for cultivation, as it is practically on the barren belt along the height of land. The land near Muskeg lake is low and swampy, and covered with small spruce growing close together. East of this to near Molesworth lake there is a larger growth of spruce. From Molesworth lake to Spirit lake the land is mostly dry and sandy, and covered with Banksian pine. This area was completely fire swept during the present summer (1906), so that for two or three miles there is scarcely a green tree. In following the trail from the cache on the Kinojevis river to Molesworth lake, the first two miles are over good soil heavily wooded with spruce and poplar, followed by an open, dry, mossy country, with small scrub spruce and Banksian pine. North of this there is nearly a mile of muskeg, almost without trees, and from this to the railway line is the sandy plain burnt bare already referred to.

Along the line from Spirit lake to the Harricanaw river there are miles of spruce swamp growing an abundance of pulp wood. The trees are tall and straight, and are from 4 inches to 10 inches in diameter with an occasional one of larger size. Near the river, where the land is drained by small streams, it is dry, and the soil appears to be of excellent quality and free from stones.

Kinojevis Cache to Seals Home Lake.

Going from the Kinojevis cache to Seals Home lake by way of the Nawapitechin river, Kewagama and Newagama lakes, there is an excellent canoe route. There are two slight rapids on the Nawapitechin river a short distance below the cache, after which there is smooth water flowing through a rich clay soil, up to within two miles of Kewagama lake. Here there is a small rapid, passed by a portage five chains long. One mile from the lake another portage 20 chains long passes another rapid. The shores of Kewagama lake are rocky in places, but heavily wooded with all the trees found in the neighbourhood; and besides these red and white pine are found in limited quantities. Stunted black ash is common at the mouths of streams, and low scrubby cedar line the shores. Newagama, or

9513—p. 18

Cache No. 9, Nawapitechin river, showing typical river forest.

Little Turn Back lake, is on the same level as Kewagama, and is connected with it by a broad, sluggish, marshy stream. The route to Seals Home lake follows a river flowing into Newagama lake on the north shore, the mouth of which is easily missed, as it is in a deep grassy bay.

The portage to Seals Home lake, over the height of land, leaves a small branch of this river flowing from the east, about one mile from the lake. The portage is two miles long and passes over a level well wooded country. At the east end it stops at a small stream, which in midsummer is almost dry, necessitating a farther carry of a quarter or half a mile. The stream winds through a wide marsh almost a mile before reaching the lake.

Seals Home Lake.

Seals Home lake is made up of three expansions, connected by two narrows. The most northerly narrows is quite river-like for over a mile, although at ordinary water there is no visible current. The south part is the largest. It is irregularly circular in shape, having the longest diameter northeast and southwest, and measuring eight and a half miles. There are numerous islands in the southern part. Counting in the lower expansion the whole lake measures twenty-four miles from north to south. The shore line is indented with numerous bays, and bare rocks are frequently exposed, forming low cliffs. The shores are well wooded with spruce, poplar, etc., and an occasional pine.

Peter Brown creek enters the lower expansion of Seals Home lake from the east. It is 100 feet wide at the mouth, and is easily navigable with canoes to within less than a mile of the railway line, which crosses this creek nine miles east of the Harricanaw river. There is some excellent, well wooded agricultural land along this creek.

Harricanaw River.

The Harricanaw river drains Seals Home lake, and for twenty-two miles flows a little east of north, then it flows northwest as far as it was followed. The railway line crosses four miles below the lake. At this point the river is 5 chains wide, and it averages between 4 and 6 chains as far as it was surveyed. At the cache a half mile below the crossing of the railway line there is a rapid, with a fall of three feet, which can be run by light canoes.

A short distance farther down another shallow rapid occurs. The next rapid is a mile and a quarter farther down, where the fall is only two and a half feet. Below this the river continues smooth water for nearly five miles, where there is another rather strong rapid, but we were able to let our canoes down all of these without portaging. Six miles farther north the river expands into Obalski lake, which is six miles long and over a mile and a half wide at the north end. This lake has a number of small islands near the middle. The shores are mostly low and wooded, with some hills showing in the distance to the west and north. For a mile and a half below Obalski lake the river is broad and sluggish, with low banks. Three and a half miles below the lake there are three rapids close together, having a fall of six or seven feet. These can be passed in ordinary water with partly loaded canoes. The river was surveyed two miles below these rapids, but no stream large enough to go up in a canoe was reached. The stream from Molesworth lake enters the Harricanaw somewhere below this point, but as I was informed it was only two miles from the lake, I concluded it must be one of the small streams I had passed, which in the present condition of the water was too small to navigate. I learned from Indians and prospectors that a short distance farther down the river is one continuous rapid for a long distance, and is consequently not much used as a canoe route. For the most part the banks of the Harricanaw are low, and composed of clay loam. In most places the land rises gently back from the river for a few chains, and then becomes level, the slopes adjacent to the river being cut into ridges by rivulets.

Askogwash River.

The Askogwash river, which flows into Seals Home lake from the east, was surveyed almost to its source, following the most northerly branch. Where it enters Seals Home lake it is over 2 chains wide, and this width continues up to the portage to Natagagan lake, and some distance beyond. The banks are marshy, and covered with grass, in some places from 5 to 10 chains back from the river. The current is sluggish, and there are three lake expansions, one of which is said to extend to the south for several miles. East of Wookey lake the river is about a chain wide for six miles. In this distance there are several shallow rapids over gravelly bottoms, where canoes cannot pass except at high water. This stream forks

six miles from the lake, and divides about equally, one branch coming from the north, which is probably the stream called Cedar creek at the crossing of the railway line, and the other coming from the east, near Wabanoni lake. The latter branch was followed almost to its source, beaver dams on the upper part facilitating canoe travel. From this branch a portage nearly two miles long leads south, mostly through muskeg, to Wabanoni lake, which discharges into the Bell river.

Natagagan Lake and River.

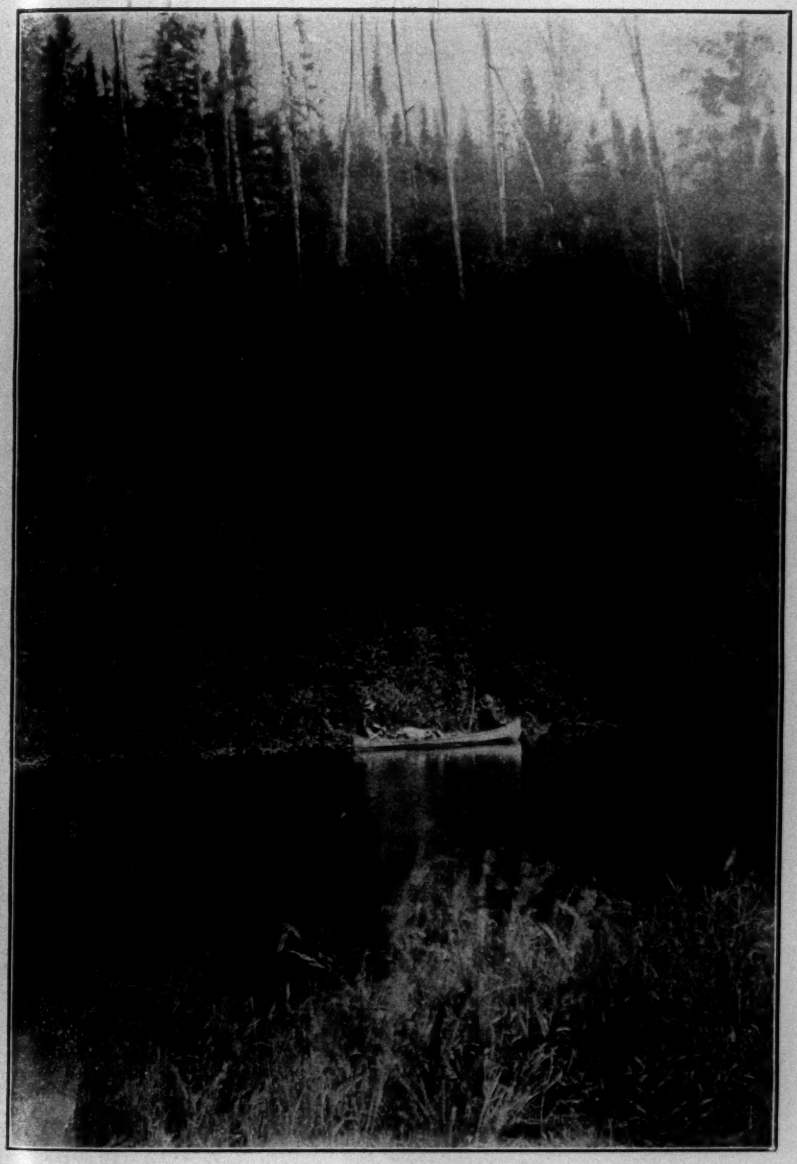
Between twenty-two and twenty-three miles east of Seals Home lake, on the Askogwash river, a canoe route leads south to Natagagan lake. There are altogether four portages and three small lakes between the river and Natagagan lake. The first portage is 150 chains long. There is a low hill rising from the river, which is heavily wooded for nearly half a mile, then an open muskeg and swamp for a quarter of a mile. The remainder of this portage is through a rather thick spruce swamp, in places decidedly wet. The water in this lake is clear, and differs from the other rivers and lakes described, the waters of which are more or less dark and muddy. So much is this the case in some of them that it is impossible to see rocks or other obstructions, though only a few inches below the surface. The second portage is 96 chains long, and is through a spruce swamp. For a short distance there is a dry Banksian pine knoll, and about 6 chains of muskeg. The small lake between the second and third portage is only 15 chains long. It is also clear water. The third portage is one mile long, and for the first half passes over a dry sandy Banksian pine plain. The northern half is over a low hill covered with a luxuriant forest growth of spruce, poplar, canoe-birch, and fir, with mountain maple abundant. I noted *acer rubrum* at the third lake, but it was of small size. The third lake is also of clear water, and is 33 chains across. The fourth portage is a mile and a half long, and parts of it are over good agricultural land, on which are growing some of the largest trees seen in the district. Besides the ordinary varieties *Betula papyrifera*, variety *cordifolia*, was also noted on this portage. The trees are tall and straight, and 3 inches to 4 inches in diameter. The hazel and wild red cherry also grow abundantly. This portage ends at a stream which flows from the third lake. Where the portage reaches it the stream is only wide enough to allow a canoe to pass, and at the present stage of

water hardly deep enough to float a partly loaded canoe. This brook is followed for 25 chains, when Natagagan lake is entered. This lake is five miles long and not much over a mile wide. A long point projects from the west side, and a deep bay is on the east. The lake gradually narrows toward the north end. The shores are low, and rise back from the lake in gentle slopes to a height of a hundred feet or more. The Natagagan river flows from the north end of the lake. It is narrow and has many short bends, but the general course is fairly straight, being about 15° east of north. At four and a-half miles below the lake the railway line crosses, and nearly five miles farther down the river makes a long curve to the west. In order to reach ten miles below the line it was necessary to make over seventeen miles of survey. In this distance there are only three rapids and two short portages, the greatest fall at any rapid being 8 feet.

Along Railway Eastward from Harricanaw River.

Going eastward along the railway line from the Harricanaw river the forest has been largely burnt during the present summer, especially on the drier parts. This condition prevails up to Peter Brown creek, and for a mile east. East of this for five miles the country is largely muskeg, with spruce swamp having small spruce up to 10 inches. The sixth mile is through an open Banksian pine plain, which is followed by drier ground drained by a large brook flowing to the north. Between this and the Natagagan river there is an alternation of spruce swamp, Banksian pine plains, and some high ground having fairly good soil. The larger areas are covered with spruce swamp. Excursions north and south of the line between these rivers showed that the general character of the country is the same.

Going east from the Natagagan to the Bell river, following the railway line, the first mile is through a large spruce forest. Then follow three miles of muskeg, after which to Cedar creek is a spruce swamp. The first mile east of Cedar creek is through muskeg, followed by wet spruce swamps and knolls of dry ground. About nine miles from the Natagagan river there is another large open muskeg, extending three miles along the line, and from one to two miles wide. East of this muskeg there is a spruce swamp, followed by a mile of dry rich ground, growing spruce 2



Natagagan river: forest showing dead tamarack.

feet in diameter, and large canoe-birch. From this to the Bell river the country is the same as that already described. There are some areas covered by large quantities of spruce up to 10 inches in diameter and 40 to 50 feet high, which will make excellent pulpwood if the forest is protected from fire. For about a mile from the Bell river, on the south line, there is a dense growth of small spruce 2 inches in diameter.

Wabanoni Lake.

A track survey was made of the stream forming the headwaters of the Askogwash river, and the portage from it to Wabanoni lake. In order to fix the south end of this portage a compass and micrometer survey was made of Wabanoni lake, and tied to station eighty-four of D. M. Mill's survey of the Bell river.

Wabanoni lake is rectangular in shape. Its greatest length is five miles from southeast to northwest, and it varies in width from two to three miles. It receives a large stream near the middle point of the west shore, and another at the northwest angle, where the portage above referred to leaves the lake. The shores are mostly low and well wooded. Several rock exposures occur along the east and south shores, which in places are also lined with walls of boulders. The outlet is from the southeast bay into Obaska lake and is through swampy ground. The stream is broad and sluggish, and about halfway to Obaska lake expands into a lake nearly a mile long. This expansion receives a slow winding stream of considerable size, from the south.

Obaska Lake and Adjacent Railway Line.

Obaska lake is eleven miles long, and, except in one place, is not much over a mile wide. There is a long narrow island near the north end and a few small ones near it, but for the rest the lake is open. It is bordered in the northern part by low clay shores densely wooded, but southward hills of considerable size rise from the lake.

The south railway trial line which crosses Obaska lake at the outlet was examined to the east. The land goes back from the lake comparatively level. Near the river there is a second growth of small spruce and poplar, followed to the east by a dry sandy Banksian pine knoll. This is succeeded by a spruce swamp, where small black spruce with alders abound. At two and a half miles from the river there is an open muskeg, with a low hill to the north. This proved

to be a low rocky ridge, with good clay soil on the slopes, covered with trees of a fair size. This is the general character of the country through to the first crossing of the Migiskan river, a distance of about twelve miles from Bell river.

The railway line crosses the Migiskan river about twelve miles from its mouth in Shabogama lake. The approximate location line joins the first or south line a little over a mile and a half west of the river crossing, but only a short distance from the stream, as the river at this point flows west. In walking westward on the location line the usual good forest was noted along the river, but back from the river the land is flat, and covered with a dense growth of small spruce 1 inch to 4 inches in diameter, with occasional clumps of Banksian pine. This is the condition to Christmas creek, which flows through a low country to Lake Shabogama, and, I was told, is easily navigated with canoes. For a considerable distance westward there is a low flat country, drained by this stream, the forest being a second growth of spruce. In a northwest direction there seems to be an extensive muskeg, followed by a low ridge, to the southwest of which Bell River mountain rises. This mountain shows three rounded peaks. Along the line to the east of Christmas creek the soil is a white clay, into which the roots of the trees do not penetrate far, as upturned trees show a net-work of roots only a few inches below the surface.

In going east along the railway line from the Migiskan river there is a succession of black spruce swamp, muskeg, and an occasional knoll or hill, with good dry soil covered with large spruce, poplar, and canoe-birch. A mile and a half from the river there is a granite ridge which runs to the northwest, and apparently crosses the river at the first rapid above the railway line. At the foot of this hill there is some good soil with large trees. The top of the hill is 250 feet higher and is rough and rocky. As viewed from this elevation the country is generally level, with an occasional mountain showing in the distance. About half way to Sunday brook there is an open muskeg, from which there is a view of a prominent range of hills, four or five miles to the north.

Migiskan River.

The Migiskan river empties into Lake Shabogama, and from the mouth up to the railway crossing, about twelve miles, is almost all

rapids and difficult to navigate with canoes. One mile above the railway line there is a rapid passed by a 13 chain portage, on the west bank. Up to this portage the banks are low and well wooded, except in one place where there are steep clay banks 10 to 15 feet high. The clay is tough and of a whitish colour. The river averages about 8 chains in width up to the railway cache, and generally has low sloping banks of good clay soil. From the railway line to the mouth of Sunday brook six streams enter the river, each from 15 to 20 feet wide. One from the south, two miles below Sunday brook, is considerably larger, and forms part of a canoe route between the Migiskan and Garden Island lake. Besides these there are numerous rivulets entering from both sides. In ascending the Migiskan, two miles above Sunday brook, there is a rapid which is passed by a 15 chain portage on the north side, but canoes can be poled up and run down with light loads. Two and a quarter miles farther up there is a slight rapid, up which the canoes were pulled without making a portage. Two and a half miles above this there is a rather bad rapid, which has a portage 14 chains long on the north side, but it can be run with light canoes. One mile above this rapid Crooked creek enters from the north. Below Crooked creek the forest is all green and of the usual kind, but up to the railway cache, one mile and a half, the forest has been recently burnt. Six observations for latitude were taken at the cache opposite the mouth of the Assup river, the average being 48° 12′ 35″. At this point the Migiskan is 500 feet wide, and it keeps this width for most of the distance up to the portage into Millie lake. It is deep and has considerable current, with four or five places where there is swift water or slight rapids, but none of these require a portage. A rather bad rapid is half a mile below the mouth of the Atik river, and the worst one a mile and a half below Trout brook. The portage into Millie lake is over a mile and a half long, the river in this distance being a rapid with a fall of about 60 feet. The soil on the portage is sandy, and was covered with a small second growth of Banksian pine, but it has recently been burnt, and is now practically bare.

Sunday Brook.

Sunday brook enters the Migiskan river from the north, about eight and a half miles above the railway crossing. It is a crooked

stream, flowing through good clay soil well wooded with small spruce and Banksian pine. No rock was seen on this stream, but angular granite boulders are common.

Crooked Creek.

Crooked creek empties into the Migiskan river eighteen miles above the railway line, following the bends of the river. It winds in a very sinuous course through low clay banks which rarely reach more than 10 feet in height. The forest along the lower part, for five or six miles, was burned in 1906. Above this the forest is small, the spruce seldom reaching more than a foot in diameter. Several isolated hills were noted in ascending the stream to the railway line. Some of these are 75 to 100 feet high and are mostly bare and rocky. Near the railway line the soil is poor and sandy, covered with Banksian pine recently burnt. North of the railway line the creek runs through a scraggy bush, with clay banks often covered with grass. At a distance of eight miles north of the railway line the hills close in on the stream, which at this distance is small. Looking down the creek from an elevation, a ridge of high hills is seen to extend along both sides of the stream at some distance back from it, and to the north and northwest similar hills stretch for a long distance. Seen from this point the country is decidedly hilly, with some low swampy tracts. The hills are covered with green forest, some trees being apparently of large size. I noted on a hill 250 feet above the creek some large spruce, canoe-birch, and fir, growing on rich soil; Banksian pine large enough to make good railway ties was seen in some places. The hazel bush and mountain maple are also abundant on the rich slopes. The valley of Crooked creek can be seen for a distance of four or five miles winding among the hills to the north.

Assup River.

The Assup river is locally known as the Yukon, but as the perpetuation of that name would lead to confusion I have called it the Assup, an Indian word meaning fishnet. At the mouth and for five or six miles up it is a deep sluggish stream, flowing from the south through a wide swampy valley, with low hills on each side at a distance of one or two miles. It forms part of the canoe route from Grand Lake Victoria, and is connected with Matchimanitou lake

by a four mile portage. When the water is low the stream is too shallow in the upper part to float canoes, so that the portage is considerably lengthened.

Along Railway East and West of Crooked Creek.

On the railway line east of Crooked creek there is a Banksian pine plain burnt bare. South of the line there are several bare hills at a distance of one to two miles, and northward there is a range of hills 300 to 400 feet above the line, or about 1,500 feet above sea-level. One mile and a half east of the creek the soil is sandy on top, but is underlain by boulder clay of a greyish colour containing small boulders 3 inches to 4 inches in diameter, and in one place shows stratified sand and gravel. At two miles east of Crooked creek low hills close in on the line, the soil is poor, and the forest is nearly all destroyed by fire. This is the general character of the country to Trout brook. Trout brook empties into the Migiskan, a mile and a quarter below the portage to Millie lake. It is bordered on both sides by ranges of high hills, some of which rise to a height of 1,600 feet or more above sea-level.

In following the railway line west from Crooked creek the first four miles is through open muskeg, some of it very wet, interspersed with areas of spruce swamp. Hills of considerable height rise to the north of the line three miles west of the creek. These hills are two or three miles distant and are well wooded. The country bordering on Sunday creek is drier and has some good spruce forest.

Millie Lake.

Millie lake is an expansion of the Migiskan river. It lies in a northeasterly direction, and for nine and a half miles is from a mile to a mile and a half wide. Above this it narrows to a quarter of a mile in places, but seems to continue at the same level three or four miles. It is a beautiful lake, with many sandy beaches and points, and is everywhere surrounded by rounded hills, which rise to a considerable height. They are generally well wooded. Through depressions between the hills several streams enter the lake. The principal of these from the south are Cedar creek, Smoky creek, and Bear brook. From the northwest there is only one large stream, which enters near the north end and rises not far from Crooked creek.

Smoky Creek and Cedar Creek.

Smoky creek is bordered with low hills showing an abundance of rock exposures. Near the lake there is some good soil and good forest of large poplar and canoe-birch, but along the trial line farther inland the country is either burnt or covered with small second growth, and the soil is poor. These conditions prevail along Cedar creek and down to the foot of Millie lake. Smoky creek abounds in small speckled trout, averaging about 6 inches in length.

The Atik River and Adjacent Country.

The Atik river is the largest branch of the Migiskan, and has a total length of sixty-five or seventy miles. It was surveyed by compass and micrometer from the mouth to the north end of Durant lake, a distance of sixty-five miles following the sinuosities of the river. It is probable that the source of this river is in a stream flowing north, and entering Durant lake at the south end. This stream was ascended in canoes for over five miles, when it became rapid, but of considerable size. For the first twenty-three miles, or up to the Hill cache, the Atik is very crooked, and has numerous rapids. The first portage is one mile from the mouth, and is seventeen and a half chains long over a burnt, sandy, Banksian pine plain. The river at this rapid falls about 15 feet, and is full of boulders. There is on each side a morainic ridge which seems to have caused the rapid and supplied the large number of boulders. No solid rock is seen. The country along this part of the river was all burnt in 1906, though there are a few green clumps of trees still standing. The Atik flows through a sandy country up to the Hill cache, with occasional strips of alluvium along the banks. The banks are usually from 5 to 10 feet high, but near the mouth of Cañon creek the sand banks are very much higher and continue so up to the Hill cache, where the western end of the portage is up this steep hill.

The principal forest trees along this stretch are Banksian pine, spruce, and poplar, the two latter being found principally on the lower ground. Some of the Banksian pine are large enough to make railway ties, but such trees are by no means abundant.

Cañon creek enters the Atik about a mile below the Hill cache. It is a small winding clear stream flowing over a sandy or gravelly bottom, with sandy banks from 10 to 100 feet high, covered

with Banksian pine. In walking east along the railway line from the crossing of Cañon creek the country is an open Banksian pine plain, with groves of tall straight trees, some of which are a foot in diameter, but most of them are small. To the west, between Cañon creek and the Migiskan river, the line runs through a level sandy plain cut into deep gullies wherever there are streams. These gullies are from 50 to 100 feet deep, with sides as steep as sandy clay will remain at rest. Several holes were dug along the line, and these showed sand or gravel. The forest growth is open Banksian pine, mostly small second growth, but a few trees reach a foot in diameter. For three miles east of the Migiskan the country has been burned within the last three years. An abundant crop of blueberries was growing over this region. Viewed from the top of a hill, the country to the north and northwest is hilly, but southward there are no high elevations in sight.

The Hill Cache portage on the Atik is 69 chains long and, except at the west end, is a good trail over level ground. An examination of the country south of the Hill Cache portage showed the same conditions as described on the north. Banksian pine plains, with an occasional spruce swamp mixed with canoe-birch, prevail over the area explored. Two miles south of the river there is a narrow lake a mile and a half long, with an outlet from the eastern end. No hills or rocks could be seen. Above the Hill Cache portage the river is not so crooked, but much more rapid, with several lake expansions. Up to the outlet of Atik lake, a little over sixteen miles, there are thirteen rapids, the longest being nearly half a mile. Most of these rapids can be run with partly loaded canoes, but they have to be poled up, or the canoes dragged by hand. There are no good portages cut out past any of these rapids, but some of the worst have poor trails. In this distance there are two lake expansions of considerable size. The most easterly is called Mark lake, and is a mile and three-quarters long, but narrow.

At six miles and a half above the Hill Cache portage a trial line runs north to the north line at Maher lake, a distance of five miles. This line follows the valley of a small stream, and is through rather poor soil with scrub Banksian pine and low shrubs. At the lakes on the north line there are several kame-like ridges of sand and gravel, with areas of wet swamp and muskeg.

An examination was also made south of the Atik, opposite the trial line, for a distance of five miles. In this distance there is an

alternation of Banksian pine plain and spruce swamp, with a number of green tamarack trees.

In proceeding up the river there is little change in the appearance of the country. The banks are densely lined with alders and willows, and the land back from the stream is sandy and covered with slender Banksian pine up to 3 inches or 4 inches in diameter.

A shallow stream a mile long, with two rapids, drains Atik lake. The lake is divided into three parts by two narrows, and is five miles long and from a half to one mile wide. The south part is filled with long, narrow, sometimes crescent-shaped islands, which are kame-like in appearance, and probably of glacial origin, as they are composed of sand and gravel. The shores are mostly sandy, and lined with small water-worn pebbles. The middle expansion is the largest, and is free from islands, but some of the bays have beautiful sandy shores. The third part is also free from islands, except three small ones. The forest along Atik lake is small second growth, but there are some hills with large canoe-birch and spruce.

Couillard lake is connected with Atik lake by a small stream thirteen chains long. The lake is a mile and a half long, and irregular in shape. In the south it is swampy, and is surrounded with black spruce. In the north, kame-like sandy ridges form long points, enclosing deep bays.

From the outlet of Atik lake to Durant lake, a distance of nine miles and a half, there are eleven rapids, one of which is a chute, and two are a quarter of a mile long. The only regular portage is at the chute, all the others can be run and poled up. There is more spruce for some distance from the outlet of Atik lake than on most of the lower part of the river, but from the middle of Buckle lake the forest was burnt in 1906. At the Atik cache, three miles below Durant lake, there are some fair-sized Banksian pine which will make good railway ties. From the cache up to Durant lake the land is sandy and poor, with scrub forest.

Durant Lake.

Durant lake has a bay on the west a mile long, from which the Atik river flows. From the southern part of this bay a narrow channel leads southeast into the main lake, which lies in a northeast direction for four miles. This lake is divided into two parts by a narrows, where the National Transcontinental Railway line

crosses. The lake is in most places surrounded by low shores with considerable areas of good soil and large forest growth, especially along the west side. I walked back northwest from the lake at the north end, and ascended a hill 200 feet above the lake and 1,500 feet above sea-level. This hill is well wooded and has canoe-birch on it a foot in diameter, and Banksian pine 15 inches. I noted also wild red cherry 7 inches in diameter and over 50 feet high. The variety of the canoe-birch, *cordifolia*, grows here.

The route up to Schulfer lake is through a poor, hilly country. From a hill to the north of the lake a good view of the surrounding country was had. Close to the hill, to the east, there are low ridges running east and west, with muskeg and swamp between. Farther east, at a distance of over five miles, there are ranges of high hills To the north there is a low burnt sandy plain, and to the west is Durant lake, with a rolling country beyond.

At the south end of Durant lake a stream of considerable size enters. This stream flows north and is probably the continuation of the Atik river. The country drained by this river is hilly, and in places there are large granite boulders. About two miles south of the lake a large moraine crosses the stream and runs southeast, and farther south there is a sand hill, or ridge, running in the same direction. The country has been recently burnt, so that the surface features can readily be seen. For five miles the general features are the same, with high hills three miles south.

Durant Lake to Kekek River.

East of Durant lake there is no regular canoe route, but a number of small winding streams and lakes, with long portages between, have been used by the engineers of the National Transcontinental railway. This was followed, but time would not permit me to make more than a track survey. The stream followed flows into Durant lake on the east side near the north end. A portage of 8 chains starts from the lake north of the mouth of the stream. This stream is a mile and a half long, and flows from a narrow lake a mile long, through a poor swampy country, recently burnt, with low hills a short distance back. A portage of 10 chains over a Banksian pine knoll leads to a larger lake a mile and a half long. From this a portage of 70 chains leads south to Armstrong lake. This portage is through a burnt Banksian pine country, with small areas

of muskeg. Armstrong lake is also narrow, and about a mile long, with sloping shores and low hills. The portage from Armstrong lake runs south to Jack lake and is 93 chains long. It is over hills and muskeg, and is partly burnt. It has some green forest, with fair-sized trees on the southern part. Jack lake is about a mile long and not much more than a quarter of a mile wide, and is surrounded by green hills fairly well wooded. All these small narrow lakes lie nearly east and west, agreeing closely in direction with the strike of the rock. A portage of 60 chains leads southeast to Steele lake, which is over a mile long and irregular in shape. A two mile portage leads from Steele lake to the Kekek river, over a Banksian pine plain. The Kekek river was followed to the crossing of the railway line, and northward for several miles. This stream where the portage reaches it is small, and for miles winds through grassy banks and alders. On the south side there is a range of hills at least 200 feet above the river. There is only one short portage until the railway line is reached. There are several fresh beaver dams on this stream, and beaver cuttings are strewn all along the river. Three miles below the railway line I walked back east from the river, and found the country a succession of hills and valleys trending east and west. Some of the hills rise 300 feet above the general level. Small narrow lakes occupy many of the valleys, and the hills are well covered with large spruce, poplar, paper-birch, and Banksian pine, some of the latter over a foot in diameter. I noted large wild red cherry and rowan trees up to 4 inches in diameter. On the slopes of many of these hills there are tracts of good agricultural soil. Going northward down the river the same conditions prevail. The country is rolling, the granite hills alternating with muskeg and swamp. Some of the hills are covered with spruce, poplar, and canoe-birch, while on others there is little else than Banksian pine.

Kekek River to Kapitachuan.

The canoe route from the Kekek river to the Kapitachuan waters leaves the former where the river turns north. A portage of 28 chains leads to a small pond, near which the National Transcontinental Railway line crosses the portage. From the small pond a portage of 9 chains leads to a long narrow lake, which after a mile becomes a narrow winding stream for two miles, again expanding into a series of lakes and ponds joined by short streams, until

the height of land between the Kekek and Kapitachuan waters is reached. Before reaching the last lake, on the north slope, there is a portage of 30 chains, and the height of land is 52 chains. From the height of land less than two miles of small lakes, and a brook hardly wide enough for a canoe to pass through, leads to the Kapitachuan river. The soil is generally poor and the forest growth small along this route, from the Kekek river, but along the Kapitachuan down to the lake there is good clay soil, and a thick forest of small spruce with no Banksian pine. From Kapitachuan lake the river was ascended to Blacksand lake. It is very crooked, winding through clay soil, wooded chiefly with small spruce. Blacksand lake is over four miles long and about a mile wide, and has many islands and deep bays. From Blacksand lake a portage leads east for 25 chains through a muskeg to a small lake, and from this lake a portage of 50 chains leads to a small brook running into Whiteshore lake. This stream is a chain wide, and in places expands into long narrow lakes. It has one fall of ten feet, which is passed by a short portage on the south bank. There are small areas of good alluvium along the river, but the banks are generally sandy and covered with Banksian pine. This river has also several fresh beaver dams on it, and recent beaver cuttings are common.

Whiteshore Lake.

Whiteshore lake is so named because of the white sandy beaches along its shores. It is surrounded by low hills well wooded with small spruce, poplar, and birch.

The railway line passes close to the south end of the lake, and runs eastward for the first half mile through an open Banksian pine wood, and beyond this to the Susie river through wet spruce swamp and small areas of muskeg. The Susie river flows into Whiteshore lake and is a stream of considerable size. Where the trail crosses there are two falls, aggregating twenty feet, over a typical garnetiferous gneiss. The exploration was not carried farther east than the Susie river.

DESCRIPTION OF THE ROCK EXPOSURES.

Fly River.

About one-half mile up the Fly river there is an exposure of a fine-grained, dark hornblende schist, composed largely of small, irregular prisms of green hornblende with irregular oval or lense-like

areas, streaks, and imperfect bands of plagioclase feldspar, and quartz. It also contains specks of pyrite. At the first portage, about one mile from Makamik lake, the rock is a hornblende schist striking N 84° W vertical. It contains small lenticular masses of a rusty, reddish quartz. Near the middle of the rapid the rock is more disturbed, and there are several quartz veins parallel with the strike and containing pyrite. The same kind of rock extends up the river for 10 chains. Three-quarters of a mile farther up the river there is a similar rock, but of a lighter colour, which probably contains some mica. In ascending the river the next rock seen is a small exposure of hornblende granite, medium grained, composed largely of feldspar of which plagioclase is the chief variety. This exposure is covered at ordinary high water. A half mile above this, green schist holding considerable pyrite is seen, and a short distance east of this, where the river bends to the northwest, there is a massive, fine-grained, reddish granite, composed largely of feldspar. It is traversed in places by fine veins of red feldspar. Next above this there is a hornblende schist, which is a fine-grained aggregate of green hornblende, plagioclase, and orthoclase feldspar, with considerable magnetite and a small amount of biotite. A short distance above the second portage there is a small outcrop of hornblende-granite. At the third portage mica schist occurs, and seems to strike north and south, vertical. This schist contains numerous veins and pockets of quartz, but no minerals of economic value were observed in any of them. At the forks west of Owl mountain there is a dioritic rock composed almost entirely of large green hornblende individuals, with a small amount of interstitial feldspar. Two miles above this on the south branch there is an exposure of diabase, and this is succeeded by a fine greenish grey hornblende-schist, which extends as far as the river was followed, strike, N 26° E vertical.

The ridge along the top of Owl mountain is diabase, flanked by a dark fine-grained hornblende schist. The same schistose rocks form a low hill half a mile to the east. The strike is east and west, vertical, and forms in places perpendicular walls of considerable height. Through all these rocks large veins of white and pinkish quartz extend for long distances. These veins are not continuous, but in places are of considerable width, and are said by prospectors to extend for at least three miles to the east.

Along Railway Eastward from Fly River.

In going eastward along the northern exploration line from Fly river the rocks are much the same as seen on Fly river. They consist of small, widely separated exposures of chloritic and hornblende schists. There are two areas of a fine-grained granite and one of diabase. The granite occurs in a considerable elevation on the line, and north of this point there is a hill about a mile distant which is also granite. Granite boulders are plentifully scattered over the ground in this area. An amygdaloidal schist occurs at one place, the cavities being elongated and filled with calcite. Another calcareous exposure is coated to the depth of a quarter of an inch with ochre. Other bands are full of cubes of pyrite. This is the general character of the rocks as seen for a distance of eighteen miles, then the line passes through low swampy ground and muskeg, and there are no rock exposures until Spirit lake is reached, where there are exposures of calcareous and hornblende schists, with dikes of diabase. Between Spirit lake and the Harricanaw river no rock was seen, either on the line or adjacent to it.

Kakameonan and Makamik Lakes.

The rocks, as far as examined on the Kakameonan river, are green schists. A short distance above where the north branch enters there is a spring which has deposited a considerable quantity of brown ochre. Rocks of the Keewatin group outcrop along the south shore of Makamik lake, and Mr. Johnston reports similar rock along the west side also.

On the south exploration line the only rocks seen were hornblende and chlorite schist, and small dikes of diabase. About half a mile from Lois river there is an exposure containing many quartz veins, some of which hold copper pyrites, but in small quantities. These rocks are much disturbed. They strike nearly east and west, and are mostly vertical.

Height of Land Portage and Nawapitechin River.

In passing over the four mile portage from Lois lake to the Ottawa waters glaciated rock exposures are seen at several points. They are much altered, and vary from chlorite schist to light green, fine-grained, ashy rocks, broken and cemented again by quartz

veins. Traces of iron ore are seen along the portage. At the west end of the three-quarter mile portage on the southwest branch of the Nawapitechin river, there are bands of a fissile sericite schist, striking N 60° W vertical, and grading into this is a calcareous greenish rock weathering to the depth of half an inch, the weathered part being a rusty brown ochre. Small quartz veins cut both these rocks. Opposite this, on the west side of the brook, there is a vein of quartz over a foot wide, containing large crystals of pyrite.

The northwest branch of the Nawapitechin showed nothing but green schists much altered, and a porphyry which seems to be sheared and decomposed, in which can still be distinguished plagioclase phenocrysts lying in a quartzose ground. In coming down the Nawapitechin valley the same kind of rocks are seen in small exposures very widely separated.

The only rocks exposed on the Kewagama river are at the two rapids, 'At both of which there are exposures of a rusty, somewhat gneissic biotite schist, striking northeast.'[1]

Seals Home Lake and Harricanaw River.

Rock exposures are of frequent occurrence along the shores of Seals Home lake. In going down the west shore from the height of land portage the first rock met with is a fine-grained diabasic rock, much altered and containing cubes of pyrite. This is followed by a chlorite schist, also holding pyrite, and north of this there are small areas of acid granites and foliated mica gneiss. Near the middle of the first narrows, at a projection on the west side, there is a dioritic rock composed largely of hornblende and quartz. About half a mile west of this point the rock is a diabase, and is followed, going north, by green chloritic schists which are altered and decomposed. On the west side of the second expansion there is a very acid muscovite granite, which changes into a coarse pegmatite, composed largely of vitreous quartz and feldspar, probably orthoclase. For a considerable distance north of this there are no rock exposures, the shores being low and marshy. In the southern part of the second expansion there is a small island of rusty weathering granite cut by veins of white quartz, some of which are three feet wide, and others mere thread-like streaks. Molybdenite in small quantity was found in one of these veins. On the east shore, south

[1] Geological Survey of Canada, Summary Report, 1901, p. 137 A.

9913—p. 36

Height of land, Four-mile Portage, one mile east of Lois Lake, showing glaciation and forest.

of the island, a biotite schist occurs, dipping N 11° E <50°. Along the second narrows there is a knob of dolomitic rock much broken up, striking N 69° W, with a small quartz vein crossing the strike. In the south part of the third expansion there is a slate rock dipping N <70°. It contains pyrite, and is cut by small quartz veins. North of this the ordinary green schists, striking east and west, are seen. These schists appear at the rapids, which occur at considerable intervals down the river. In most places they are much altered and show great variety in the different exposures. At the fourth rapid, which is between seven and a half and eight miles north of the railway line, the rock consists of altered diabase much disturbed, and north of this, but not showing contact, a reddish grey granite. The former is cut by quartz veins, which hold copper pyrites in small quantities. Below this, as far as the river was followed, hornblende and chlorite schists are the common rock, and these are well seen on the shores of Obalski lake, and also at the rapids two and a half miles farther down. On a projecting point half a mile northeast of the entrance, Mr. R. Harvie, of Montreal, reports a 2 inch vein of copper pyrites, which runs across a mass of submerged rock and is visible for twenty-five feet.

Askogwash River.

The Askogwash river shows very few rock exposures, as the banks are low and marshy for a long distance back from the river. Those seen on the west part were green schist. About two miles above Wookey lake, going east, there are several outcrops of an altered diabase, and above this altered porphyries and chloritic schists occur at considerable distances apart. Besides these one or two exposures of typical diabase were seen.

Four miles east of the Harricanaw river, on the railway line, there is a chlorite schist holding pyrite, and cut by thread-like veins of quartz, and at seven miles, on a hill some distance north of the line, Mr. J. Obalski, Superintendent of Mines for Quebec, saw serpentine containing small threads of asbestos not exceeding a quarter of an inch, but he found no fibre of commercial value.[1]

Natagagan Lake and River.

No rock exposures were seen on the first three portages into Natagagan lake; on the fourth, or most northerly portage, there is an

[1] Mining Operations in the Province of Quebec, 1906, by J. Obalski.

exposure of a dark green chlorite schist, striking N 57° W vertical. This schist is crumpled in places, and contains specks of pyrite and chalcopyrite. On Natagagan lake, on the east side near the point where the brook enters, there is an exposure of rock dipping N E $<30°$. This rock contains much light coloured pyrite and weathers a rusty brown. There are no rock exposures on the west shore for over one mile below the marshy point. Here there is a diabasic rock containing stringers of quartz, and showing foliation running east and west. Along the northern part of the lake there are several outcrops of chlorite schist, and also on the river for eighteen miles below the lake. At the first rapid the schist contains small quantities of calcite, and at the portage two miles farther down there is a sericite schist striking N 72° W vertical. Small bands of a bluish quartz run parallel with this schist. There are also one or two small outcrops of granite on this river. On the railway line, over three miles west of the river, there is a grey micaceous schist holding numerous cubes of pyrite. A little over a mile west of this there is another exposure at a camp ground, where the rock is a fissile, crumbling schist, holding large masses of quartz, and in places much pyrite. For nearly a mile west these fine schists are common. Considerable quantities of calcite are also present. The dip is N 18° E $<60°$. At eight miles from the river there is an exposure of green schist weathering a greyish-white and dipping N 8° E $<65°$; and associated with it there is a massive ashy rock.

Ascending the small stream flowing into Wookey lake from the east, the first rock exposure is about two miles up. It is a chlorite schist but only of small extent. Farther up for half a mile there are several small outcrops, somewhat granitic and diabasic in character. Above the forks there are two small exposures of the ordinary green schists. No more rock is seen on this route until Wabanoni lake is reached.

Wabanoni Lake.

At the point opposite the outlet of Wabanoni lake the rock is an altered diabase, but parts of the thin sections look like a hornblende schist. Rock of a similar character is seen round the point, and for a mile or more along the east shore. This rock in places is quartzitic, where it contains large quantities of disseminated pyrite. On the south shore there is a gneiss, probably a crushed granite. The section is almost wholly composed of feldspar and quartz, with

secondary minerals resulting from the decomposition of the feldspar. There is scarcely a trace of any original coloured constituents. Quartz is very abundant and furnishes complete evidence of the results of deforming stresses. The individuals often appear to have been crushed to fine aggregates. The feldspars include both plagioclase and orthoclase varieties. The structure is that of a dynamically deformed granite, possibly of a pre-existing gneiss. This is followed, going west, by an altered diabase, in one place grading into a green schist. The diabasic rock occurs in several exposures on the south shore, and for more than a mile north along the west shore. The northern part of the west shore is low and swampy, and the north shore is low, being either sandy or bouldery.

Obaska Lake.

On the west shore of Obaska lake, three miles and a half north of the mouth of Wabamoni river, there are two small exposures of chlorite schist. A slide from this rock shows it to be very finely granular, and the bulk of it seems to be a mat of green chlorite, in places thickly peppered with tiny grains of epidote. In other parts the chlorite is replaced by quartz or feldspar, with abundant epidote.

Two and a half miles east of Obaska lake, on the south exploration railway line there is a low ridge where the rock is a dark green hornblende schist. Under the microscope, in thin section, it is seen to be composed of numerous large irregular masses of green hornblende lying in a mat of fine-grained, fibrous hornblende, epidote, and quartz. This rock is cut by small veins of quartz, showing pyrite along the contacts. On the same ridge there is an exposure of an ashy rock, weathering white. On this railway line, about three miles west of the Migiskan river, there is a hornblende, pyroxene rock, which looks like a narrow dike. In thin section it seems to represent a rock once composed essentially of green hornblende and colourless augite, often in intricate intergrowths with one another. Chlorite and other secondary products also are present. A short distance east of the above exposure the rock is a biotite gneiss, composed largely of quartz and feldspar, including both plagioclase and orthoclase. The slide suggests a once coarse granitic rock irregularly granulated. The biotite is greenish brown and not very abundant; with it occurs some epidote apparently formed prior to the mica. The ridge in which this rock occurs runs northwest

and southeast, but the strike could not be determined definitely. Four chains south of this ridge, and parallel to it, there is another low hill, composed of hornblende schist, which shows in outcrops for a quarter of a mile back; then the land goes off level, and is covered with clay, no more rock showing, as far as examined.

On the location line to Christmas creek the only rock seen was a banded biotite gneiss, essentially composed of a very abundant microcline and orthoclase, much plagioclase and quartz, and some biotite. The individual grains vary much in size down to very small forms. There is a distinct banded structure, marked not only by the occurrence of the small shred-like flakes of biotite along certain bands, but also by the variation in the size of grain of the colourless constituents in alternating zones. Granite and gneiss boulders are common in places.

On the railway line at the base of a hill, a mile and a half east of the Migiskan river, the rock is a quartzose granite of light grey colour, and farther up the hill there is another exposure of the same character, but slightly yellow. Near the top there is pinkish biotite gneiss, which in thin section is seen to be essentially composed of abundant plagioclase feldspar, microcline, and quartz. A few small flakes of green biotite are also present. The rock is of medium to fine grain, and presents many of the structures of an ordinary granite, somewhat modified by crushing, and possibly accompanied by a certain amount of recrystallization. The gneissic structure is not prominent in the hand specimen, but in places in the field it is distinct. Half-way to Sunday brook there is an exposure of deformed biotite-hornblende granite, which is medium to coarse-grained and composed of very abundant quartz and microcline, and much orthoclase and plagioclase feldspar. Considerable biotite, often with associated epidote, is present, and many small irregular prisms of hornblende occur. The structure is much like that of a normal granite, but modified by pressure. East of this to Sunday brook the rock, wherever exposed, is a fine even-grained biotite granite.

Migiskan River.

The only rock seen in place on the Migiskan river between the western crossing of the railway line and the Migiskan cache is at the rapid one mile above the railway line. The rock at this rapid

is a grey granite with an abundance of quartz, and resembles closely the rock already described from the railway line east of the river.

The rocks on the hill on the west side of the Assup river, about two miles south of the Migiskan, are hornblende schists. One specimen under the microscope seems to be closely allied to the diabases. It is largely a matted aggregate of fibrous hornblende, with shreds of biotite and chlorite, and comparatively large grains of epidote. Another specimen from this hill is a hornblende gneiss or schist (amphibolite). The section is a fine-grained aggregate of green hornblende and feldspar, largely plagioclase. The rock is evidently metamorphic, and is possibly derived from a tuff, or some basic igneous rock, volcanic or plutonic.

On the east side of the Assup river and about one mile south of the Migiskan, there are exposures of chlorite schist and chlorite-hornblende schist, dipping S 60° W $<75°$. Some of these outcrops contain veins of calcite intimately mixed with the schists, and holding small grains of pyrite. There are also masses of quartz of considerable size.

On the Migiskan, two miles below the mouth of the Atik following the river, there is a small exposure of a fine-grained hornblende schist. The section shows the rock to be composed largely of hornblende and plagioclase feldspar, with the hornblende in excess. This is the most easterly exposure of the Keewatin rocks. The next outcrop is nearly two miles above the Atik, at a strong rapid. The rock here is a biotite gneiss, composed chiefly of quartz, plagioclase, and orthoclase feldspar, abundant biotite, much epidote, with associated allanite, and a few small garnets. Mixed with this biotite gneiss there are bands of a coarser, lighter coloured rock, composed largely of white and pink feldspar, with a little quartz and biotite. There is another exposure of a similar gneiss at the second bend below the mouth of Trout brook.

On the portage into Millie lake, one mile from the south end, there is a reddish weathering biotite gneiss containing small crystals of magnetite. The rock is cut by pegmatite dikes, in which there are small irregular masses of magnetite. The thin section shows a rather fine-grained mosaic of quartz feldspars, biotite, and epidote, the last two in small quantity.

Millie Lake.

The hills surrounding Millie lake were found to be, as far as examined, composed of granitic rock with gneissic structure. The strike varies considerably, but is generally N 40° W to N 65° W. There are many pegmatite dikes, of which the most abundant constituent is feldspar. On the east side of the lake, near the outlet, the rock is a biotite gneiss. It is rather decomposed, and secondary chlorite, calcite, epidote, sericitic mica, and kaolin are abundant. Below the mouth of Smoky creek the rock is a hornblende gneiss or schist. It is a fine and even-grained aggregate of green hornblende and feldspar, largely plagioclase. Near the north end of the lake the rock is a slightly foliated granite. It is composed of quartz, orthoclase, microcline, and acid plagioclase feldspar. Three miles from the outlet, on the northwest shore, the rock is a biotite-hornblende gneiss of medium grain, and contains, besides quartz, feldspar, and biotite, small grains of sphene and epidote. Close to the outlet on the same shore there is a well foliated biotite gneiss, which is almost wholly composed of quartz and feldspar, with a small amount of green biotite in roughly parallel flakes. Besides the above specimens, which were examined under the microscope, there are exposures in almost every hill surrounding this lake, presenting practically the same characters as those described.

Atik River.

In ascending the Atik river the first rock in place was found in a hill on the north side, two miles and a half below the Hill cache. This rock is a hornblende, biotite gneiss, and dips N 30° W < 30°. The examination of the section leaves the impression that the rock represents a crushed, partially reconstructed hornblende granite. The chief constituents are acid plagioclase, orthoclase, and quartz, together with hornblende and greenish biotite. The individuals are, in the main, so arranged as to give a very pronounced foliation.

On the railway line three miles west of Cañon creek there is an acid granite composed largely of quartz and feldspar. The biotite is greenish, and the flakes are charged with regularly orientated minute needles, possibly of rutile. On a hill north of the line, and one mile west of the creek, there is an outcrop of biotite gneiss of the ordinary type, and a fine-grained gneiss occurs near the creek south of the line.

On the Atik river the next rock is at the east end of the Hill Cache portage, where a well foliated acid biotite gneiss occurs, striking N 51° E. The section consists of very abundant quartz and feldspar (plagioclase, orthoclase, and microcline), with not very much greenish biotite, in comparatively large flakes, with some associated muscovite. This is one of those uncertain types suggesting a reconstructed rock, which either once was coarse-grained, perhaps a granite, and had been arrested in its progress toward complete granulation, or else was a fine-grained type, stayed in the process of recrystallization into a coarser one.

One mile above the portage on the south side there is an exposure of fine-grained gneissoid granite, made up largely of quartz and feldspar. The same rock outcrops in several places, up to where the tie line runs north to Maher lake. In going north along this line biotite granite or gneiss is the common rock. The first exposure is in a low hill near the Atik. The rock is a biotite granite, and is a medium, rather even-grained aggregate of quartz and feldspar, with considerable green biotite and associated epidote. Over a mile and a half along the line there is an exposure, 10 chains wide, of typical diabase, slightly decomposed. Constant exposures of biotite, granite, and gneiss, striking nearly east and west, occur up to Maher lake. I went west along the northern railway line for some distance, and found gneissoid granite and gneiss in several places. At the outlet of Lena lake there is an exposure of gneiss, striking N 53° W, and dipping N 37° E $<30°$. An examination of the country south of the Atik and opposite the tie line, showed only granite and gneiss. At four and a half miles south there is a biotite gneiss, which is a medium-grained rock largely made up of acid plagioclase, feldspar, quartz, and biotite. With the abundant greenish biotite occurs much epidote. A few flakes of muscovite are also present. Near this there is a foliated gneiss of regular bands of hornblende, quartz, and a little feldspar.

Ascending the Atik river, there are many exposures of gneiss up to the outlet of Atik lake. Some of the rock is foliated, and strikes east and west, vertical, but some exposures are more massive. Quartz and feldspar are abundant in these rocks, with small quantities of biotite and hornblende.

In Atik and Couillard lakes the only rock seen was gneiss. On the west shore of the middle expansion of Atik lake there is a much

contorted hornblende biotite gneiss, which is of medium to fine grain, and is composed of plagioclase feldspar, with much biotite, and some green hornblende and quartz, with a few grains of epidote.

In going up the river from the outlet of Atik lake the next rock observed was on the railway line south of the Atik cache. This is a garnetiferous-biotite-hornblende gneiss, striking N 80° W vertically. The section is largely composed of quartz and plagioclase feldspar, with considerable biotite and a less amount of hornblende. This rock shows in a most marked way the effects of pressure. Along the rapids above the cache, garnetiferous gneiss is common, and at the fall and portage a mile farther up the same rock occurs. At this point the gneiss is full of small, well formed garnet crystals, much weathered and decomposed on the surface. The gneiss is distributed and broken up by a dike-like mass of diabase, and is also cut at a sharp angle by a pegmatite dike, which in places has the appearance of augen structure. The thin section shows the diabase to be a typical one, though the augite is somewhat decomposed, and the individual grains often changed to hornblende. Olivine does not appear ever to have been present, and iron ore is notably small in amount. Just below Durant lake, on the south bank of the river, there are a number of exposures of biotite hornblende gneiss, striking east and west. The thin section shows a finely granular rock, composed mostly of quartz and feldspars, amongst which plagioclase predominates, with much green hornblende and brown biotite.

Durant Lake.

Several exposures of gneiss were seen on Durant lake, especially on the east shore. The strike is nearly east and west, and they dip at a high angle, or are vertical. At the narrows the rock is a biotite gneiss, which is composed of plagioclase and orthoclase feldspars, abundant quartz, and considerable greenish-brown biotite. The rock varies much in size of grain and its structure is decidedly granitic.

On the small ponds and streams, up to Schulfer lake, the common rock is garnetiferous gneiss, dipping S $<80°$. On the top of the hill north of Schulfer lake the rock is a garnetiferous hornblende schist, of which garnet is a prominent constituent, occurring either as isolated grains or occupying large areas enclosing numerous grains of hornblende or quartz.

The hills along the stream flowing into Durant lake from the south abound in rock exposures. About two miles south of the lake there is a garnetiferous-biotite gneiss, which is a good example of a dynamically formed rock. South of this the ordinary biotite gneiss occurs, and at a distance of five miles the rock is a muscovite gneiss in which the quartz is in distinct bands.

Durant Lake to Kekek River.

Only a limited number of rock exposures are seen along the route between Durant lake and the Kekek river. A well foliated and acid gneiss is exposed at the east end of the portage out of Durant lake. On the portage north of Armstrong lake, 35 chains from the north end, there is a good exposure of garnetiferous gneiss. The strike is east and west and the dip S $<50°$. A 2 inch band of quartz and plagioclase feldspar, packed with small garnet crystals, runs through the whole exposure. Exposures of gneissic rock were seen in the hills surrounding Armstrong lake, and on the portage south to Jack lake. At the south end of the portage at Jack lake the rock is a much altered gneiss containing large quantities of pyrite. Outcrops of gneiss occur on the portage between Jack lake and Steele lake, and on Steele lake there is a much weathered garnetiferous, biotite gneiss, largely composed of quartz, plagioclase, feldspar, and very abundant reddish brown biotite. The mica flakes are often comparatively large, and so arranged as to give a marked foliated structure to the rock. On the portage from Steele lake to the Kekek river a fine, unevenly granular biotite gneiss occurs, which is composed chiefly of quartz and plagioclase feldspar, with much orthoclase, and considerable green biotite. On the Kekek river the only rock seen was gneiss and granite. The general strike is east and west, and the layers are mostly vertical. In nearly every case they contain garnets in fairly well formed crystals.

Kekek River to Whiteshore Lake.

Along the route between the Kekek and Kapitąchuan rivers a few exposures of gneiss and gneissoid, quartzose granite were noted. On Blacksand lake, near the outlet, there is a gneissic rock, and on the east side of the middle expansion there are several exposures of the same rock striking N 70° E, dip S 20° E $<85°$. The rock

here is a biotite, hornblende gneiss. Under the microscope the rock is seen to be fine-grained, and to possess an eminently granular structure. Feldspars, amongst which plagioclase excels, are very abundant, exceeding the quartz in bulk. Small flakes of green biotite are common, and with them often occur small rough prisms of green hornblende. A number of small irregular grains of garnet occur here and there. On the first small lake east of Blacksand there is an acid granite, which is coarse-grained and composed largely of quartz and acid plagioclase feldspar. Scarcely any coloured constituent is present in the rock. The quartz grains show prominent strain shadows and other phenomena, the result of pressure. At the fall on the stream into Whiteshore lake there is a rather rotten biotite gneiss, distinctly foliated, mixed with fresher bands showing less foliation. The dip is S 20° E <60°. On the south shore of Whiteshore lake there is a hornblende gneiss, dipping S 15° E <80°. Along the east shore ordinary gneissic rock is exposed near the south end of the lake, striking N 63° E, and farther north there is a beautiful garnetiferous biotite gneiss, which is a medium to fine-grained aggregate of quartz and plagioclase feldspar, with considerable brown biotite and a number of irregular grains of garnet.

ECONOMIC GEOLOGY.

A large part of the eastern half of the area examined is underlain by Keewatin rocks which contain numerous quartz veins, but so far as examined, no minerals of economic promise were found, though careful prospecting may reveal such minerals.

Chalcopyrite.

On the location line of the National Transcontinental railway, a half mile east of the Lois river, crossing the rock, is an altered diabase, which contains veins of quartz from half an inch to a foot wide. Some of these veins contain chalcopyrite, which has coloured the rock green, but as far as could be seen on the surface the quantity of copper ore is small.

On the Harricanaw river, about eight miles north of the railway crossing, at a rapid, there are small quantities of chalcopyrite, in the quartz veins which traverse the rock, and farther north on the

same river, at the south end of Obalski lake, there is a 2 inch vein of the same material, which is exposed in a submerged rock for 25 feet.

Molybdenite.

An examination was made of the area in Kewagama lake where molybdenite was found by Mr. J. F. E. Johnston in 1901.[1] The granite in which the molybdenite occurs occupies most of the peninsula which divides the lake into two parts. It outcrops at intervals for over three miles on the east side. Mr. Johnston also found it a mile and a half north of the narrows on the west side; and it forms hills almost up to the north end of the peninsula. It, therefore, has an area of approximately seven square miles. It is a biotite granite, composed of orthoclase, microcline, plagioclase, feldspar, and quartz, with a relatively small amount of biotite, and associated muscovite. The rock is in part at least deformed, the quartz is usually fractured and in places granulated, and to a lesser degree this is true of the feldspars.

The molybdenite is best seen at a narrow point which projects about 15 chains, near the middle of the east shore. Here the granite is cut by vitreous and reddish-rusty quartz veins, from half an inch to 4 feet in thickness. Many of these veins run northwest and southeast and are cut by others running in different directions. Some of them have clear-cut walls and are very distinct. They all contain molybdenite, usually in thin crystals, the largest seen being an inch in diameter. Bismuthenite in small quantity was found associated with the molybdenite. Along the shore, to the south, the granite is seen in occasional outcrops for a mile and a half, and contains quartz veins with small molybdenite crystals. Some of the hills back from the lake were examined, and the same conditions were found to prevail as at the shore, except that there were fewer veins and less molybdenite, but the latter could be found in all the veins.

In the middle expansion of Seals Home lake there is a small island composed of grey granite, which is traversed by quartz veins, some of large size. In one a few crystals of molybdenite were found, but the amount, as far as seen on the surface, was too small to be of commercial value.

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[1] Geological Survey of Canada, Summary Report, 1901, p. 138.

Mr. J. Obalski, Superintendent of Mines for Quebec, reports[1] that he visited the Kewagama river in September, 1907, and found that the Height of Land Mining Company had prospected the country between the two rapids on that river. He says: 'The Company has taken out a mining licence on the west side, and, a little above the lower rapid, has sunk a shaft, which was thirty-five feet deep at the time of my visit. The shaft first cut through a vein of pegmatite six feet thick, and afterwards another at the bottom.

'These veins, wherein quartz predominates, have an east and west direction, and seem to cross the river. Molybdenite, in crystals and in masses, is found in it, also bismuthenite, or oxide of bismuth, in fairly considerable quantities, and native bismuth. These minerals seem to be regularly scattered throughout the mass. A little chalcopyrite and native copper are found more accidentally, and only in small quantities. Accompanying the pegmatite some crystals of a yellowish mineral are also found, which seems to be beryl.

'It is impossible to give a definite opinion regarding the value of this prospect, but the presence of these minerals in fairly abundant quantities is an encouragement to continue the work.'

Gold and Bismuthenite.

A sample of quartz from the point on Kewagama lake, collected by Mr. Johnston, was assayed under Dr. Hoffmann's direction, and gave 0·117 of an ounce of gold to the ton of 2,000 lbs. Other adjacent quartz veins carried bismuthenite.

Iron.

Slight indications of iron were noted at a few points, but nowhere in sufficient quantity to be of economic value. Rocks resembling those associated with iron ore in other Keewatin districts were seen on the portages from the Nawapitechin river to Lois lake, and on the railway line to the north, but whether they represent the regular Lake Superior iron ore formation I could not determine. As most of the area is not readily accessible, and few rock exposures are visible, only careful and thorough prospecting can decide whether this or other valuable minerals occur.

[1] Mining Operations in the Province of Quebec, 1907, by J. Obalski.

Clay.

Four miles east of the Natagagan river, on the railway line, where a hole was dug to get water, a sample of clay was collected, which is probably of glacial origin, but resembles closely the Leda clay of the lower levels. Mr. F. G. Wait, chemist of the Mines Branch, Department of Mines, reports as follows on a sample submitted to him for examination: 'The sample of clay, from a point on the National Transcontinental railway four miles east of the Natagagan river, has been examined and found to be:—

(*a*) Rather strongly plastic.
(*b*) Slightly ferruginous.
(*c*) Slightly calcareous.
(*d*) Somewhat strongly magnesian.

It contains little or no siliceous gritty matter—sand. When moulded into form and burned it yields a very strong, but readily fusible product. It would be suitable for the manufacture of bricks, tiles, and coarse pottery.'

Farther east, about seven miles from Bell river, at another opening in a moss covered swamp, the clay thrown up is a typical boulder clay. Fifty boulders were counted on the heap, varying from 2 inches to 1 foot in diameter. They were partly rounded and well striated. Eight were granite and gneiss, and the rest green schists or diabase. This clay is of a bluish-drab colour, and extends over a large area.

Asbestos.

Seven miles east of the Harricanaw river, on a hill a short distance north of the railway line, there is a serpentine rock containing small threads of asbestos, not exceeding a quarter of an inch in length.

TIMBER.

Spruce trees large enough to make sawlogs grow close to the rivers and lakes, and wherever the land is sufficiently elevated to afford good drainage. Such areas are found all over the western part of the sheet, but especially on Fly river, Makamik lake, Lois river, Nawapitechin river, Harricanaw river, Peter Brown creek, Natagagan river, Bell river, and Migiskan river; and to a less extent on the Atik river, and other rivers and lakes to the east. The

spruce in some places reaches a diameter of 20 inches, but this size is rare, the average being a foot to 15 inches, and trees of this size are not abundant. Poplar and canoe-birch up to a foot in diameter grow in the same localities.

By far the most abundant, and probably the most valuable trees, are the black spruce, which grow tall and close together, and are from 4 to 10 inches in diameter. Trees of this size are plentiful in most of the spruce swamps, which abound over the whole area, but the best trees are found west of Bell river. As explained in a preceding page this tree will make excellent pulpwood.

Banksian pine grows abundantly on the sandy areas in the eastern part of the sheet. In some places a few of these trees reach a sufficient size to make railway ties, but most of them are too small.

GLACIATION.

The whole country has been heavily glaciated by ice moving from the north over the height of land. Almost every rock exposure in the Keewatin area is polished and grooved and well rounded on the north side, while the south side is abrupt and broken. This is well seen on the islands and shores of lakes, especially so in Seals Home lake. Eastward, as far as Bell river, well marked striæ are common, exposures sometimes showing two courses crossing each other.

On the Laurentian area the striæ are not well preserved, as the rock weathers readily. There is, however, other evidence of glacial action, such as the kame-like ridges of sand and gravel and the kettle holes which are occasionally seen in the sandy plains; also the generally smoothed surface of rock exposures which, though not showing striæ, bear evidence of erosion.

The following striæ were noted: On the height of land between the Nawapitechin river and Lake Lois the course is S 10° E and S 20° E true meridian; on the south side of Makamik lake, S 10° E; Obalski lake, on the Harricanaw river, S 19° E; Seals Home lake, S 19° E; Wabanoni lake, S 38° W., Obaska lake, S 18° W. The boulders observed were chiefly granite, gneiss, and green schists, such as are found in places all over the area.

In many places the shores of the lakes are lined with boulders piled on top of each other to a height of several feet, and forming a solid wall for a long distance. These boulders are usually smooth

and well rounded, but seldom show striæ. Their present position is evidently due to recent ice action. Similar phenomena have been noted on the principal lakes in northern Ontario.

An interesting feature in the pleistocene geology was observed in connexion with the open muskegs, particularly as to their mode of formation. In some cases they seem to be the remains of shallow lakes. Originally the water occupied the whole space now covered by the muskeg, but heath plants and moss began to encroach on the water, beginning at the outer rim and working toward the centre. The margin kept on slowly widening as each dry season caused the water to recede, until in time only the deepest parts remained open water, and finally the whole lake was filled. In many of these muskegs small ponds of clear water may still be seen, which have to be approached with care as the moss is easily penetrated. In some ponds I examined I could not reach the bottom with any poles I could secure. On the second lake on the route into Natagagan lake this process of filling up is well seen, as it is now actually in progress. The small lake at the south end has a rim of quaking vegetable matter several chains wide, which occupies more than half the original size of the lake. Besides the moss, *Kalmia glauca, Ledum lutifolium,* and *Cassandra calyculata* grow abundantly on the rim. At the point where the canoes are put into the water it is necessary to lay poles and brush on the trail, as there are only a few feet of vegetable material floating on the water. When this mass was penetrated there seemed no further obstruction to sinking a pole as far as it would reach. The outline and general shape of many muskegs at once suggest the form of a lake, the margins having bay-like indentations and points corresponding to those seen on lakes. It is probable, however, that lakes filled up in this way are such as have little or no outlet.

RAILWAY LEVELS.

The following levels on the line of the National Transcontinental railway were obtained from Mr. K. Weatherbee, assistant engineer of District C, and are above mean sea-level at Quebec:—

	Feet.	Bed.
Lake Abitibi, high water level	870	
Whitefish river, water level	870	
Lois river	915	
Kakameonan river, water level	994	982

	Feet.	Bed.
Robertson lake, water level	1,004	
Summit, 2½ miles west of crossing of branch of the Nawapitechin river	....	1,074
Branch of the Nawapitechin river, water level	978	968
Molesworth lake, water level	1,003	
Spirit lake, water level	1,036	
Harricanaw river, water level	971	942
Peter Brown creek, water level	1,003	
Summit, 5 miles east of Peter Brown creek	....	1,124
Natagagan river, water level	1,000	986
Summit, 2 miles west of Coffee river	....	1,084
Coffee river, water level	1,007	
Bell river, water level	994	983
Migiskan river, west crossing, water level	1,071	1,058
Sunday brook, water level	1,092	
Crooked creek, water level	1,123	
Migiskan river, east crossing, water level	1,158	
Cañon creek, water level	1,139	
Atik river, at outlet from Atik lake, water level	1,277	
Durant lake, water level	1,327	
Steele lake, water level	1,353	
Kekek river, water level	1,364	
Hamilton lake, water level	1,427	
Susie river	1,394	

INDEX

A

PAGE.

Agricultural land 9, 16, 17, 19, 22, 31, 33
Armstrong lake 31
Asbestos.. .. ..37, 49
Askogwash river 21, 23
" character of.. 20
" rocks of.. 37
" survey of.. 8
Assup river, character of.. 26
" rocks of.. 41
" survey of.. 8
Atik lake, character of.. 30
" rocks of.. 43
" survey of.. 8
Atik river, character of.. 28
" rocks of.. 42
" survey of.. 8

B

Bear brook.. 27
Beaver dams.. .. ..15, 17, 33
Bell, Dr. R., survey by.. 7
Bell River mountain.. 24
Bell river, surveys of 7, 8
Bignell, John, survey by 8
Bismuthenite 47, 48
Blacksand lake.. 33
" rocks of.. 45
Blueberries.. 29
Brock, R. W., survey by.. 7

C

Cañon creek.. 28
Cedar creek.. .. ..21, 22, 27, 28
Chalcopyrite.. .. ..46, 48
Christmas creek.. 24
Clay.. 49
Cochrane, A. C., survey by.. 7
Copper (see Pyrite and Chalcopyrite).
Couillard lake, character of.. 30
" rocks of.. 43
" survey of.. 8
Crooked creek.. .. ..25, 26

D

PAGE.

Durant lake, character of.. 30
" rocks of.. 44
" survey of.. 8

E

Economic geology.. 46

F

Fish.. 28
Fires, forest destroyed by 18, 22, 25, 26, 27, 28, 29, 30, 31
Flora of the district 9, 51
Fly river, character of.. 15
" rock exposures on.. 33
" survey of 8
Forest, character of.. ..9, 11, 15, 16, 17, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 49

G

Geology of the district 12
Glaciation.. .. ..35, 50
Gold 48

H

Harricanaw river, character of.. 19
" survey of.. 8
Harvey, C. L., survey by.. 8
Height of Land Mining Co... 48
" where crossed by N.T.Ry.. 8
Hill Cache portage 29
Historical.. 7
Hoffmann, assay by.. 48

I

Iron ore.. .. ..36, 48

J

Jack lake.. 32
" rocks of,.. 45
Johnston, J. F. E., gold and bismuthenite found by.. 48
" molybdenite found by.. 47
" survey by.. 8

K

Kakameonan river.. 15
" rocks of.. 35
Kapitachuan river.. 33
Keewatin rocks.. .. ..12, 35, 41, 46
Kekek river, character of.. 32
" rocks of.. 45
" survey of.. 8
Kewagama lake.. 18
" river, rocks of.. 36
Kinojevis river, survey of.. 8

L

PAGE.
Laurentian.. .. .. 13, 50
Levels along National Transcontinental Ry.. 51
Little Turn Back lake (see Newagama).
Lois lake, character of.. 16
" survey of.. 8
Lois river.. 16
" survey of.. 8

M

Makamik lake, character of.. 16
" survey of.. 8
Mark lake.. 29
Migiskan river, character of 25
" rocks of.. 40
" survey of 7, 8
Mill, D. M., survey of Bell river by, referred to.. 23
Millie lake, character of.. 27
" rocks near 41, 42
Molybdenite.. .. ..47, 48
Muskegs, formation of.. 51

N

Natagagan lake.. 21
" rocks of.. 38
" survey of.. 8
Natagagan river.. 21
" rocks of.. 37
" survey of.. 8
National Transcontinental railway.. .. ..8, 17, 22, 27
" " levels on.. 51
" " rock exposures 35, 40
Nawapitechin river, character of.. .. ..17, 18
" rocks of.. 36
" survey of.. 8
Newagama lake.. 18

O

Obalski, J., report on visit to Kewagama river.. 48
" serpentine seen by.. 37
Obalski lake.. 20
Obaska lake.. 23
" rocks of.. 39
Ogassasan river.. 16
O'Sullivan, Henry, survey by.. 8
Ottawa river, survey of headwaters of 8
Owl mountain.. 15
" rocks near.. 34

P

PAGE.
Peter Brown creek.. 19
Pine trees, northern limit of.. 10
Pulpwood.. .. ..10, 23, 50
Pyrite, presence of 13, 34, 35, 36, 37, 38, 39

R

Robertson lake.. 8

S

Seals Home lake, character of.. 19
" molybdenite at.. 47
" rocks of.. 36
" survey of.. 8
Serpentine.. .. ..37, 49
Shabogama lake.. 24
Smoky creek.. .. ..27, 28
Spirit lake.. 35
Steele lake.. 32
" rocks of.. 45
Sunday brook.. 25
Surveys of district by N.T.R. engineers 8
Susie river, character of.. 33
" elevation at.. 9

T

Timber.. 49
Topography.. 9
Trout brook.. 27

W

Wabanoni lake.. .. ..21, 28
" rocks of 38
" survey of.. 8
Wait, F. G., examination of sample of clay by.. 49
Weatherbee, K., levels by.. 51
Whitefish river.. 16
Whiteshore lake.. 33
" rocks of.. 46
Wikwasika lake.. 16
Wilson, W. J., surveys by.. 8
Wookey lake.. 20

Y

Young, G. A., microscopic descriptions of rocks.. 14
Yukon river (see Assup).

AREAL GEOLOGY, EXPLORATORY

DESMELOIZES
LA REINE
LA SARRE
ROYAL
ROUSSILLON
LANGUEDOC
GUYENNE
BERRY
BEARN
LAKE ABITIBI
PALMAROLLE
POULARIS
PRIVAS
TRÉCESSON
DALQUIER
ROQUEMAURE
LAUNAY
DUPARQUET
HÉBECOURT
DESTOR
AIGUEBELLE
MANNEVILLE
VILLEMONTEL
FIGUERY
PREISSAC
LA MOTTE
MONTBRAY
DUPRAT
DUFRESNOIS
CLERICY
LA PAUSE
BOISCHATEL
ROUYN
JOANNE
BOUSQUET
CADILLAC
DASSERAT
MALARTIE
DUFAY
MONTBEILLARD
BELLECOMBE
VAUDRAY
MONTANIER
SURIMEAU
FOURNIÈRE

H.O'Sullivan's Line 1907
G. C. Rainboth's Line 1897
A. Blouin's Line 1906

Province of Quebec and Province of Ontario boundary between J. T. Patton and F. C. Laberge 1905
McFADDEN McGARRY boundary between J. L. P. O'Hanly and W. W. O'Dwyer 1874

Magnetic Declination 1908 12° 0' W.

Good agricultural land
Good soil large forest growth
Peter Brown Creek
Height of Land
Kinojevis River
Obalski Lake
Okikeska Lake
Seals Home Lake
Newagama Lake
Kewagama Lake
Lake of Islands
Kekeko Lake
Albee Lake
Crooked Lake
Long Lake
Lake Mattawagomi
Labyrinth Lake
Wabaskus Lake
Kickkick Lake
Roberteon Lake.
Lake Lois.
Spirit Lake
Agotawekami Lake
Kakakenikamak Lake
Lake Kakameonan
Lake Nakina
Lake Nakimo
Lake Nakimo
Lake Nakimo

Canada
Department of Mines
GEOLOGICAL SURVEY

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, DEPUTY MINISTER;
R. W. BROCK, DIRECTOR.

1910

78°00 77°45 77°30 77°15 77°00 76°45 76°30

Longitude West from Greenwich

Strongway Rapids
Rapid 4'
Portage
Rapid
Fall 25'
Rapid 11'
Rapid 2'
Fall 18'
Portage
Coffee River
BELL RIVER
Portages
West Branch
River
Northeast Branch
Shabogama
Northeast Bay
Southeast Branch
Rapid
Rapid
SHABOGAMA LAKE
Obalski Lake
Magnetic Declination 12° 0' W.
Good soil large forest growth
Peter Brown Creek
Natagagun River
Portage 8 chains
Rapid 8'
Rapid
Rapid
H.W. 1000'
L.W. 952'
Mag Decl. 12° 50' W.
TRANSCONTINENTAL
Okikeska Lake
Natagagun Lake
Armstrong Lake
Poplar Creek
Muskeg
Coffee River
Aldophus Creek
MICISTIKAN RIVER
H.W. 975'
L.W. 973'
bed 964'
Tucker Lake
Portage Chute
Rapid
Portage
Rapid
Mag Decl. 13° 0' W.
H.W. 985'
L.W. 1048'
bed 1035'
Rapid
Sunday Creek
1073'
Mag Decl. 13° 0' W.
1104'
Mag Decl. 13° 50' W.
H.W. 1139'
L.W. 1153'
bed
Portage
Swift current
Rapid
Millie Lake
Smoky Creek
Cedar Creek
Monta Lake
Atik L
Home Lake
Portage 152 chains
Portage 79 chains
Portage 95 chains
Portage 153 chains
Askogwash River
Weskey L.
Line 1906
Wabanoni Lake
Portages
Portage 2 miles
Obaska Lake
Jocko Lakes
Jocko Creek
Common Creek
Creek
Rapids
Portage
Swift Current
Portage 15 chains
Rapid
Rapid
Rapid

QUEBEC

76°45 76°30 76°15 76°00 75°45 75°30

48°45 48°30 48°15

Weistnagami Lake
Indian Grave
Weistnagami River
Portage
Makustigan Lake
Height of Land
Askpabonka Lake
Portage Rapid
MIGISKAN RIVER
Gauntlet
Gauntlet
Gauntlet
Kenogamishish River
Rapid
Portage
Rapid
Rapid
Wawinimata Lake
Rapid
Millie Lake
Smoky Creek
Cedar Creek
Mag. Decl. 15° 50' W.
Portage
Rapid
Jocko Creek
Jocko Lakes
Creek
Portage
Rapid
Rapid
Rapid